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ABSTRACT

Designed to determine whether as language develops particular utterances or features of an utterance are ordinarily understood before the same utterances or features are produced, this instrument consists of 10 different grammatical contrasts, called problems. Each problem includes two utterances which are identical except for some grammatical feature, and line drawings illustrate each contrast. [This document is one of those reviewed in The Research Instruments Project (TRIP) monograph, "Measures for Research and Evaluation in the English Language Arts," to be published by the Committee on Research of the National Council of Teachers of English in cooperation with the ERIC Clearinghouse on Reading and Communication Skills. A TRIP review which precedes the document lists its category (Language Development), title, author, date, and age range (preschool), and describes the instrument's purpose and physical characteristics.] (RB)

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DRAFT

Category: Language Development

Title: "The Imitation-Comprehension-Production Test" (ICP)

Author: Colin Fraser, Ursula Bellugi, and Roger Brown

Age Range: Pre-School

Description of Instrument:

Purpose - To determine whether as language develops particular utterances or features of an utterance are ordinarily understood before the same utterances or features are produced.

Date of Construction - 1963

Physical Description - The instrument consists of ten different grammatical contrasts, called problems. Each problem includes two utterances which are identical except for some grammatical feature. Line drawings, as below, illustrate each contrast.

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Pictures illustrating a grammatical contrast. Left, "The sheep is jumping"; right, "The sheep are jumping."

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The ten grammatical contrasts, sample utterances for each, and scoring criteria follow. Contrast selection was based on the possibility for pictorial representation, and the results of previous research which indicated that complete productive mastery of the contrasts involved was not common in children before about four years of age.

Practice items

The girl with the big hat.	The boy with the blue belt.
The girl playing with the doll.	The bunny eating the carrot.
The cat with the brown face.	The dog with the black tail.
The boy playing with the truck.	The mouse eating the cracker.

1. Mass noun/Count noun.
   Utterances: Some mog/A dap.
   Some pim/A ked.
   Scoring: *Some*/*A* + any nonsense syllables or appropriate English words.

2. Singular/Plural, marked by inflections.
   Utterances: The boy draws/The boys draw.
   The kitten plays/The kittens play.
   Scoring: Noun without inflection and verb with *-s*/Noun with *-s* and verb without inflection.

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3. Singular/Plural, marked by *is* and *are*.
   Utterances: The deer is running/The deer are running.
   The sheep is eating/The sheep are eating.
   Scoring: *Is*/*Are*

4. Present progressive tense/Past tense.
   Utterances: The paint is spilling/The paint spilled.
   The boy is jumping/The boy jumped.
   Scoring: *Is* and verb with *-ing*/No auxiliary and verb with *-d*.

5. Present progressive tense/Future tense.
   Utterances: The girl is drinking/The girl will drink.
   The baby is climbing/The baby will climb.
   Scoring: *Is* and verb with *-ing*/*Will* and verb without inflection.

6. Affirmative/Negative.
   Utterances: The girl is cooking/The girl is not cooking.
   The boy is sitting/The boy is not sitting.
   Scoring: Absence of *not*/Presence of *not*, + some assertion.

7. Singular/Plural, of 3rd-person possessive pronouns.
   Utterances: His wagon/Their wagon.
   Her dog/Their dog.
   Scoring: *His* or *her*/*Their*.

8. Subject/Object, in the active voice.
   Utterances: The train bumps the car/The car bumps the train.
   The mommy kisses the daddy/The daddy kisses the mommy.
   Scoring: $Noun_1$ + active form of verb + $noun_2$/$Noun_2$ + active form of verb + $noun_1$.

9. Subject/Object, in the passive voice.
   Utterances: The car is bumped by the train/The train is bumped by the car.
   The daddy is kissed by the mommy/The mommy is kissed by the daddy.
   Scoring: $Noun_1$ + verb + *d* + *by* + $noun_2$/$Noun_2$ + verb + *d* + *by* + $noun_1$.

10. Indirect object/Direct object.
    Utterances: The girl shows the cat the dog/The girl shows the dog the cat.
    The boy brings the fish the bird/The boy brings the bird the fish.
    Scoring: Any verb + $noun_1$ + $noun_2$/Any verb + $noun_2$ + $noun_1$.

During the two to three successive daily sessions typically required for ICP administration, twelve monolingual (English) subjects averaging 40 months old were required to complete three tasks per problem. The comprehension task (C) was operationalized as the correct identification of pictures named by contrasting sentences. Production was operationalized in two ways: a) as the correct imitation (I) of contrasting features in sentences without evidence of understanding; and b) as the correct production (P) of contrasting features in sentences applied appropriately to pictures.

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Validity, Reliability and Normative Data:

All nonsense syllables which were used were rated by adults for ease of pronunciation. Written and taped records were made of all test sessions. Each subject was involved in a warm-up talk session about a picture book. Two scorers independently processed all of the data. They agreed on 99% of the total number of items. Even with the restricted age range represented (37 to 43 months), there was a correlation between age and total score: $p = 0.48$, p slightly above 0.05. The six girls did somewhat better than the six boys, but the difference was not significant. Spearman rank correlations for the difficulty of problems from task to task are: $p_{IC} = 0.64$ ($p < 0.05$); $p_{CP} = 0.72$ ($p < 0.05$); $p_{IP} = 0.68$ ($p < 0.05$). Groups by task analysis of variance showed that there were significant differences among the tasks ($F = 16.05$, $df = 2/30$, $p < 0.01$). T-tests between pairs of tasks (IC, CP, and IP) indicated that all were significant with $p < 0.01$. The mean number of correct responses of subjects on I was 13.83; on C, 10.08; and on P, 4.75. Grammatical problems ranked in order of increasing total difficulty were: affirmative/negative, singular/plural of third person possessive pronouns, subject/objective in active voice, present progressive tense/future tense, singular/plural marked by is and are, present progressive tense/past tense, mass noun/count noun, singular/plural marked by inflections, subject/object in passive voice, and indirect object/direct object.

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JOURNAL OF VERBAL LEARNING AND VERBAL BEHAVIOR 2, 121-135 (1963)

Control of Grammar in Imitation, Comprehension, and Production[1]

COLIN FRASER,[2] URSULA BELLUGI, AND ROGER BROWN

Harvard University, Cambridge, Massachusetts

Most writers agree that the child understands the language of others considerably before he actually uses language himself. This sentence is from Dorothea McCarthy's comprehensive review (1954, p. 520) of research on the speech of children, and the sentence is certainly an accurate summary of what most writers have written. It is also an accurate summary of what parents believe that they have observed. We will separate out several senses of the thesis, review the relevant evidence, and report some new data bearing on the understanding and production of grammatical features in speech.

The assertion that understanding precedes production can be taken to mean that *some* utterances are ordinarily understood before *any* utterances are produced. There is strong empirical support for this thesis if we are willing to accept the production of an appropriate response as evidence that an utterance has been understood. There are just two kinds of appropriate response that have been commonly reported for children. When an utterance makes reference the child sometimes identifies the referent; when an utterance is intended to be an imperative the child sometimes performs the designated action. Gesell and Thompson (1934), for instance, tested understanding of the questions "Where is the cup?" "Where is the shoe?" "Where is the box?" by placing the child before a table on which rested a cup, a shoe, and a box and noting his identifying responses. Bühler and Hetzer (1935), in testing the child's understanding of such commands as "Get up" and "Lie down" and "Give that to me," required that the designated actions be performed. Appropriate responses of these two kinds are regularly obtained from normal children before any intelligible speech is heard. Indeed, Lenneberg (1962) has demonstrated linguistic comprehension of a high order in an 8-year-old child who is completely anarthric (speechless). In addition, the chimpanzee Gua, who was raised by the Kelloggs (1933), could, at the age of 9 months, make appropriate reaction to some 70 utterances though she never learned to speak at all. The Hayeses' chimpanzee, Viki, eventually approximated the sounds of several words but before she could do this she seemed to understand many utterances (Hayes, 1951).

The fact that some utterances usually seem to be understood before any recognizable utterances are produced is a generalization of little significance. The responses that suggest comprehension of an utterance include such very simple actions as orientation of the head, reaching, and grasping. It is not remarkable that some of these responses, those

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that are congenial to the child or animal, should come under the control of speech stimuli when the organism is not able to perform any of the culturally patterned articulatory movements that constitute speech. Any infant that can clap its hands can appear to its parents to understand "Pat-a-cake"; any animal that can run to its food dish can appear to its owner to understand "Come and get it." Certainly speech can operate as a signal for various nonverbal responses in many organisms that do not produce any speech.

The thesis that understanding precedes production is more interesting in a second form: Particular utterances or features of an utterance are ordinarily understood before the same utterances or features are produced. Our experiment is concerned with this version of the thesis in the case of particular features that are grammatical. Ervin and Miller, in their review of research on the development of language (1963) find that only a few studies have been made which bear, directly or indirectly, on the problem of the development of passive control of grammatical patterns. Neither these studies nor the ordinary observations made by parents provide evidence adequate to establish the thesis that passive control or understanding precedes productive use.

A monograph by Kahane, Kahane, and Saporta (1958) illustrates one sort of evidence. Working from previously published materials on children learning French, English, or German, the authors find that the verbal categories of tense, voice, aspect, and agreement are understood before they are marked in speech. For example, one child is reported to have said "This mine" on a certain occasion and on another occasion "Glenna on bus." There is no verb in either utterance and no marking for tense. However, the parents of the child suggest that the first utterance really means "This *is* mine" and the second, "Glenna *was* on a bus." The Kahanes and Saporta take the parents' word for it and credit the child with understanding a distinction of tense that he is not yet marking. The authors do not go on to say that the child would understand distinctions of tense in the speech of another person but that is a reasonable extension of their position.

How do parents arrive at a gloss for a child's utterance such as "Glenna was on a bus" for "Glenna on bus?" Presumably there was situational support for the linguistic expansion. Perhaps the person named was at home when the child spoke but, on the previous day, had been on a bus. In these circumstances the parents would have said, "Glenna was on a bus" and what the parents would have said is what the child is presumed to have meant. The inference may be correct but it is not appropriate for determining whether understanding does or does not precede expression. When children first begin to combine words, these combinations are "telegraphic" (Brown and Fraser, 1963) and so grammatically incomplete. If whenever a child produces such an incomplete sentence he is to be credited with understanding the complete sentence that an adult would have produced in his circumstances, then the child's understanding must necessarily seem to be in advance of his production. To make an empirical test of the assertion that understanding precedes production one must look for evidence of understanding in the behavior of the child and not simply for the absence of linguistic expression from the child combined with an interpretation by his parents.

Parents, including linguists and psychologists, often see, in their own children, behavior that they take to be evidence of a grammatical understanding that surpasses production. A child who never produces the kind of question that places the verb before the subject may nevertheless appropriately answer "Yes" (or "No") to such a question as "Are you hungry?" Before concluding that the child understands the significance of the

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with subject word order, however, one should try the effect of the single word "hungry" spoken with rising interrogative intonation and even without the intonation. A child who never produces a sentence containing both an object and a direct object may nevertheless respond appropriately to: "Bring your game to me." Again, however, one cannot tell whether the grammatical feature has been understood unless appropriate variations are used. Would the child's response change if one were to say: "Bring me to your game"? Parents do not do control experiments of this kind.

The set of sentences used by Gesell and Thompson in connection with a cup, a shoe, and a box is well designed to test understanding of the substantive words *cup*, *shoe*, and *box*. In the sentence frame "Where is the ——?" they permute the three nouns, and the response pattern reveals whether the variable element has been understood. These sentences do not test understanding of the interrogative pronoun *where* since this word is constant across all sentences. Most controlled tests of comprehension focus on the content words, especially on nouns and adjectives. However, there is an occasional exception in the literature that points the way to a test of grammatical comprehension. Gesell and Thompson, for example, have asked children to "Put the block *in* the cup" and have also asked them to "Put the block *over* the cup." By making a function word a variable they obtain evidence on the understanding of such words. No one seems to have compared this kind of evidence for the passive control of grammar in normal children with evidence of active or productive control in the same children, and we have done an experiment to fill the gap.

When we tried to think of tests of the productive control of grammar we found that production might mean any one of three things. (1) It could mean the spontaneous performance of grammatically contrasting utterances in the absence of any identifiable controlling stimuli. To find out whether particular productions of this kind had or had not occurred, an investigator would need to have the record of a child's total speech output and that is never possible. A systematic study of production must work with controlling stimuli of some kind, and here there are two possibilities: (2) The controlling stimuli could be model performances of the utterances under investigation, in which case *S*'s productions would be imitations; or (3) the controlling stimuli could be reference conditions appropriate to the emission of the utterances, in which case *S*'s performances would qualify as evidence of understanding, but the evidence would be appropriate speech rather than appropriate pointing. This third performance we will call *Production* and abbreviate as *P*; the performance that follows a model utterance we will call *Imitation* and abbreviate as *I*. The experiment we have done compares understanding or *Comprehension* (*C*) with production in the sense of *P* and also with production in the sense of *I*, but not with spontaneous production. Which kind of production it is that has been supposed to follow understanding, we cannot tell.

Operations for Testing *Imitation*, *Comprehension*, and *Production*

Consider now a concrete problem drawn from those we have devised to test *Comprehension*, *Imitation*, and *Production*. We begin with a pair of sentences: "The sheep is jumping" and "The sheep are jumping." These two sentences are identical except for the auxiliary verb, which is marked for a singular subject in the first sentence and for a plural subject in the second. Ordinarily in English the noun would also be marked (for example: "The dog is jumping" as opposed to "The dogs are jumping"), and so there would be redundancy in the grammatical marking of number. We selected the irregular noun *sheep*

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FIG. 1. Pictures illustrating a grammatical contrast. Left, "The sheep is jumping"; right, "The sheep are jumping."

so as to eliminate this redundancy and isolate a single grammatical variable.

For each of the two sentences there is an appropriate picture (see Fig. 1). In both pictures there are two sheep and a small hurdle. In one picture a single sheep jumps while the other looks on; in the other picture both sheep jump. It is necessary to have two sheep in both pictures so that a subject cannot simply match each sentence with its correct picture by noting whether the picture contains one sheep or more than one. This is necessary because the grammatical contrast presented does not encode the number of sheep present but the number of sheep performing a certain action.

There are three tasks: *I*, *C*, and *P*. For the *Comprehension* task (*C*) the *E* shows the two pictures and names them, but without revealing which name belongs to which picture. The *E* then speaks one of the sentences and asks *S* to point to the picture named. The *E* then speaks the other sentence and asks *S* to point once more. The *S* is not asked to speak at all. His appropriate response that can give evidence of comprehension is selective pointing.

In the *Imitation* procedure (*I*) no pictures are used. The *E* speaks two sentences that are grammatically equivalent to the two used in *C* (e.g., "The sheep is walking"; "The sheep are walking."). The *S* is then asked to imitate these, one at a time, following repetitions by *E*. Since we want to know whether *S* will imitate the features of the sentences that are crucial for correct pointing in the *C* procedure, we score, in the *I* task, only *S*'s retention of the contrasting *is* and *are*. His rendering of other parts of the utterance does not affect his score.

In the *Production* procedure (*P*) pictures are once again used—new pictures to match a pair of sentences grammatically equivalent to those used in the other tasks ("The sheep is eating"; "The sheep are eating"). The *S* is twice told the names of the two pictures but not which name goes with which picture. The *I* and *C* tasks by their very nature require *E* to speak the contrasting sentences twice each. The *P* task does not by its nature necessitate a repetition of the sentences, but we introduced this feature into the *P* procedure in order to equate, across tasks, *S*'s exposure to each grammatical contrast. After repeating the names of the pictures *E* points to one picture at a time and asks *S* to name it. As with the *I* procedure we score only the grammatical contrast in *S*'s rendition of the sentences, but to be scored correct for *P* the contrast has to be appropriately matched with the pictures.

Hypotheses

Imitation (*I*), *Comprehension* (*C*), and Production (*P*) will, in this paper, be called *procedures* or *tasks*. The experimental materials, we shall see, are made up of ten different grammatical contrasts, and these will be called *problems*. The contrast we have described, between the singular and the plural marked by *is* and *are*, is one such problem. Each of the ten problems was administered in all three tasks or procedures.

The rough prediction that comprehension will be superior to production can be seen

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what refined if we think about the psychological operations that would seem to be required for the tasks *I*, *C*, and *P*. For all three tasks S must notice and retain the critical difference between the two sentences that make a pair. For the sample sentences we have been considering the contrast between *is* and *are* must be attended to and encoded as a change that matters, as accidental variations of articulation and tone do not matter. A correct performance on all tasks depends upon common operations of perception, attention, and memory; the quality of these operations may depend on the nature of the sentence contrast, on its embeddedness, familiarity, the number of redundant features, and the total length of the sentences. There is reason to expect, therefore, that the order of difficulty of the ten grammatical problems should be similar in all three tasks.

There is reason to expect that the three tasks across all ten problems will show consistent differential difficulty. To perform correctly on *I* it would seem that S must not only perceive the contrast between the two sentences but must also have sufficient motor control of speech to produce the difference. To perform correctly on *C*, the S must perceive the difference between the sentences and also the difference between the two pictures and know how the referential contrast is related to the grammatical contrast; he must have motor control of pointing but need not have motor control of the speech contrast. The *P* task requires all the operations of both *I* and *C*, save only the pointing that is required for *C*. *P*, then, would seem to be more complex than *I* since *P* entails more operations than *I*. *P* would seem to be more complex than *C* since it requires control of speech rather than pointing. If the likelihood of successful performance is inversely related to the number of psychological operations that must be performed in near simultaneity, and to the complexity of these operations, then *P* should be more difficult than either *I* or *C*. In terms of the number of correct answers, then, we might expect $I > P$ and $C > P$. However, it is possible that the referential contrast offers situational support for the sentence contrast; without the pictures it may be difficult to pick up the differences in the sentences. This possibility would lead us to expect $P > I$ and $C > I$.

There are still other ways of thinking about the psychological operations underlying the three tasks. Perhaps imitation is not a purely perceptual-motor task; perhaps it usually works through the meaning system. Decroly (circa 1934), for instance, has argued that a child can only distinguish those words to which he gives a meaning, and since perceptual differentiation is necessary for imitation, imitation cannot succeed when understanding is absent. One might argue for the same prediction in a different way: perhaps, in imitation, one ordinarily decodes a sentence, retains it as a meaning, and then encodes it for production. It may be difficult to retain sentences in any form other than as meanings. This argument, like Decroly's, predicts $C > I$.

There is another possibility. Speech is a much simpler system than reference. (Brown, 1958, pp. 202-216). Speech can be analyzed into a small number of distinctive features on both the acoustic and articulational levels. The total domain of reference does not yield to any such simple systematic analysis. Consequently, we would expect control of the speech system to be more complete than control of the reference system, and that is the case since most adult speakers perfectly control speech but are far from knowing all the referential rules of their language. A sampling of referential problems of the kind used in our experiment would be likely to include some that children do not control, though these children may already control, perceptually and motorically, all the distinctive features of speech. If this were the case, then we should expect $I > C$.

There are three tasks. If we consider them

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in pairs and think only of the relation "more correct than" (>) then there are six possible outcomes. It is possible to think of a reason or a combination of reasons that will predict any of these except $P > C$. These two tasks are identical except that, where C requires selective pointing, P requires selective speech and it is difficult to conceive of speech as easier than pointing. It seems almost inevitable that $C > P$ and this prediction may be what some writers have meant when they said that comprehension precedes production. When the thesis is operationalized in this way an obviousness is exposed that goes undetected in vaguer formulations. However, if we understand the thesis to say that $C > I$ then it is not obvious since one can argue with at least equal conviction for $I > C$. The thesis does not predict the relative difficulty of I and P. The six possible relations of inequality for the tasks I, C, and P are listed in Table 1 opposite the reasons for expecting each one. The experiment was done to find out which of the possible outcomes would occur.

TABLE 1

POSSIBLE OUTCOMES AND REASONS FOR EXPECTING EACH ONE

$I > C$	*Imitation* depends only on the perceptual-motor organization of speech, whereas *Comprehension* depends on reference, and reference is more complex than speech.
$C > I$	*Imitation* is not a purely perceptual-motor task but depends upon *Comprehension*, either for the perceptual differentiation of sentences or for their retention.
$I > P$	*Production* entails all the operations of *Imitation* and, in addition, depends upon knowledge of referential distinctions.
$P > I$	The presence of the pictures in *Production* facilitates the perceptual differentiation and retention of the sentences.
$C > P$	*Comprehension* and *Production* entail the same operations except that, whereas *Comprehension* calls for control of pointing, *Production* calls for control of speech and pointing is simpler than speech.
$P > C$	No reason why this should be so.

METHOD

The Imitation-Comprehension-Production (ICP) Test. The test involves 10 grammatical contrasts. A grammatical contrast is always created by the use of two utterances which are identical but for some grammatical feature. Subjects were required to process the grammatical distinctions in each of the three ways described above.

Examples of the 10 grammatical contrasts presented in the ICP Test are listed in Table 2 together with the criteria for scoring them. These 10 problems were selected because previous work (Brown and Fraser, 1963) had shown that complete productive mastery of the contrasts involved was not common in children before about 4 years and because pictorial representations of the differences of reference were possible.

We constructed six examples of each linguistic contrast, i.e., six pairs of utterances for each of the ten contrasts. The number of morphemes in the paired utterances necessarily varies from one grammatical contrast to another, but the six examples of any one contrast are of the same length. For all utterances, words familiar to young children are used: *cat, dog, mommy, daddy, boat, truck, hat, jump*, etc. The Mass noun-Count noun contrast utilizes nonsense syllables for the reason that the referential contrast between such real words as *some milk* (mass noun) and *a cup* (count noun) is clear on the lexical level. In such a case *S* would not need to know that when a noun in the singular can be preceded by *some* that that noun must be a mass noun, and that when a noun can be preceded by *a* it must be a count noun. However, when the utterances are "some tiss" and "a heg," only the grammar of mass nouns and count nouns can guide *S* to the selection of an extended substance as *tiss* and a bounded object as a *heg*. The 12 nonsense syllables required for the Mass noun-Count noun problems were rated by adults as relatively easy to pronounce (pronounceability ratings of less than 3.5 in Appendix E of Underwood and Schulz, 1960).

For each grammatical contrast there are two utterance-pairs for I, two for C, and two for P. Tasks C and P involve a contrast of reference and so there are pictures to illustrate the utterances assigned to these procedures. The Massachusetts Institute of Technology Illustration Service made bright colored line drawings on 7×5 in. white cards. All details of the drawings were specified by the investigators following the general principle that the representations of paired utterances should be identical in every respect except the one coded by the grammatical contrast. The two pictures making a pair

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TABLE 2

[illegible] Utterances and Scoring for the ICP Test

Transitive

The girl with the hat hat — The boy with the blue belt
The girl driving with the doll — The bunny eating the carrot
The cat with the brown tail — The dog with the black tail
The boy playing with the truck — The mouse eating the cracker

1. Mentions Only/Action

Utterance — Some noun — Action — Some noun

Scoring — Noun = any nonsense syllables or appropriate English words

Singular Plural marked by inflections

Utterance — The boy draws. The boys draw.
The boy is drawing. The kids are playing.

Scoring — Noun without inflection and verb with -s; Noun with -s and verb without inflection

Singular Plural marked by is and are

Utterance — The deer is running. The deer are running.
The sheep is eating. The sheep are eating.

Scoring — *Is* = 1; *are* = 1

3. Present progressive versus Past tense

Utterance — The paint is spilling. The paint spilled.
The boy is jumping. The boy jumped.

Scoring — *Is* and verb with -ing; No auxiliary and verb with -*ed*

Present progressive versus Future tense

Utterance — The girl is drinking. The girl will drink.
The baby is crawling. The baby will crawl.

Scoring — *Is* and verb with -ing; *Will* and verb without inflection

Alternative Negative

Utterance — The girl is not looking. The girl is not looking.
The boy is sitting. The boy is not sitting.

Scoring — Absence of *not*; Presence of *not*, or some variation

Singular Plural or 3rd person present progressive

Utterance — He is sleeping. Their sleeping.
He is sleeping. He sleeping.

Scoring — *He* + *is*; *Their* + *is*

5. Subject Object in the active voice

Utterance — The train bumped the car. The car bumped the train.
The mommy kissed the daddy. The daddy kissed the mommy.

Scoring — Noun$_1$ + active form of verb + noun$_2$; Noun$_1$ + active form of verb + noun$_2$

6. Subject Object in the passive voice

Utterance — The car is bumped by the train. The train is bumped by the car.
The daddy is kissed by the mommy. The mommy is kissed by the daddy.

Scoring — Noun$_2$ + verb 2 of *be* + noun$_1$; Noun$_2$ + verb 2 of *be* + noun$_1$

7. Indirect Object Direct Object

Utterance — The girl shows the cat the dog. The girl shows the dog the cat.
The boy brings the fish the bird. The boy brings the bird the fish.

Scoring — Any verb + noun$_1$ + noun$_2$; Any verb + noun$_1$ + noun$_2$

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usually involve the same creatures and things and actions but differ in subject-object relations, in the apparent time of an action, or in the number of creatures performing an action.

In addition to the grammatical contrast items the ICP Test includes four practice items involving utterances that contrast in their substantive words, e.g., "The cat with the brown face" and "The dog with the black tail." The corresponding pictures are of the two different animals. With these items *E* instructed *S* in the three procedures: *I*, *C*, and *P*.

All of the pictures were mounted in loose-leaf photograph albums. The pictures were inserted between a sheet of backing material and a transparent cover; this proved to be a good way to preserve them from excited and sticky fingers. The pictures belonging to a contrasting pair were mounted side by side in such a way that there was no consistent relationship on any problem between the order in which a verbal contrast was given and the positions (left or right) of the pictures.

Subjects. From a pretest we learned that children 4 years of age or older performed correctly on *I*, *C*, and *P* with most of the problems. To insure that the performances should not generally be perfect we needed to work with children under 4 years and the pretest suggested that 3 years was the lowest age at which the test procedures would usually be possible. Accordingly, we worked with children whose ages ranged from 37 to 43 months, the mean being 40 months. They were 12 monolingual English-speaking children, 6 boys and 6 girls, attending one or another of 4 Cambridge, Massachusetts, preschools. In order to obtain 12 children who completed the test it was necessary to attempt the test with 15 children, and so our sample selects in favor of the cooperative child.

Order of Tasks and Problems. We wanted to be certain that consistently correct responses should be possible only for *S* having control of the grammatical contrasts presented. A *S* ought not to be able to infer correct responses from the positions of the pictures, the order of the problems, the order in which he was asked to respond to the parts of the contrast, or from any interrelationship among these variables. We also wanted our comparison of the quality of performance on *I*, *C*, and *P* to be free of practice effects. To make sure of these things we used counterbalanced and randomized orders.

Each child was to do a full set of problems with each of the three tasks. It was necessary to continue with a given task until the full set of problems was completed since a pretest demonstrated that changes back and forth among the tasks confused the *S*. Since the order in which a task was presented might affect the level of performance, each of the six possible task orders was used with two children. The scheme can be seen in Table 3.

Of the six utterance-pairs constructed for each grammatical contrast, two pairs were to be used in *I*, and for these pairs no pictures had been drawn. Pictures had been prepared for the remaining four pairs since these were to be used in *C* and *P*. Although great care was taken to make equivalent all pairs that involved the same contrast, it seemed unwise always to use one set of utterances and pictures in *C* and the other set in *P*. Consequently, we divided the pictures and the utterances, matching them in two sets, A and B; the utterances of Set A appear in Table 2. For half of the *S*s *C* was done with Set A and *P* with Set B; for the other half of the *S*s the assignment of the sets was reversed. This scheme can be seen in Table 3.

Within a task each child received the individual problems in a different random order though the same random order was used across tasks for a given child. There was one departure from randomness in these orders: the Subject-Object contrasts in the active voice were always given last. The same pictures were used for this contrast and for that in the passive voice, and we wanted to make sure that the active-voice problems had no opportunity to affect performance on the passive-voice problems. In a revised edition of the ICP Test, which we now use, this minor inconsistency has been eliminated by adding enough pictures to provide different sets for the active-voice and passive-voice problems.

Each single problem involved two utterances and both utterances were pronounced twice by *E* on all tasks. The first pronunciation simply presented the contrast, and the order in which the paired utterances were spoken was randomly determined. For tasks *I* and *C* the posing of a problem necessitated a second pronunciation (e.g., "Show me: 'The sheep are jumping.'"); but, for task *P*, the problem could be posed without a second pronunciation (e.g., "What is the name of this picture?"). A second pronunciation was, however, included in the *P* task so as to equate exposure to sentences across tasks. The second pronunciation in the *P* task immediately followed the first and reversed the order of the utterances in the first. For problems 1, 7, 8, 9, and 10 in Table 2 the order in which the paired items were posed was randomly determined in all tasks. The remaining problems (2, 3, 4, 5, and 6) were also posed, in all tasks, in a fixed order. Each of these contrasts involves a simple affirmative sentence with a singular subject and a verb in a present tense; this sentence were presented first we thought possible that *S* might point correctly and by

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TABLE 3
ORDER OF TASKS AND PROBLEMS CORRECT FOR EACH SUBJECT

Subject	Age	Sex	Order of Tasks*			Problems correct			
			1st	2nd	3rd	Imitation	Comprehension	Production	Total
E	3,5	F	C(A)	I	P(B)	18	15	12	45
G	3,6	F	I	P(A)	C(B)	17	17	10	44
L	3,7	F	P(B)	C(A)	I	18	11	9	38
F	3,1	F	C(B)	I	P(A)	17	11	8	36
G	3,5	M	C(A)	P(B)	I	17	9	6	32
K	3,3	M	P(A)	C(B)	I	13	11	4	28
D	3,3	F	I	P(B)	C(A)	15	9	3	27
R	3,3	M	I	C(B)	P(A)	13	8	3	24
I	3,6	M	P(B)	I	C(A)	10	10	2	22
I	3,2	M	P(A)	I	C(B)	12	3	2	17
H	3,3	F	C(B)	P(A)	I	7	8	1	16
V	3,1	M	I	C(A)	P(B)	9	6	0	15

* Letters in parentheses after C and P indicate use of Set A or Set B.

ing the grammatical contrast in the second step, point correctly again by exclusion. To test against such a possibility the crucial utterance in each of these contrasts was presented first in the simple base form second.

Procedure. All testing was done in the preschools in small rooms with only the child and two *E*s present. One *E*, who had previously visited the school to become acquainted with the children, administered instructions and the test materials and praised and cajoled when necessary; the other recorded a written record of the child's responses and operated a Wollensak T-1500 tape recorder, which recorded the entire session.

Before performing any of the three tasks the *S* was shown a colored picture-book and encouraged to talk about the pictures. This helped the child to become less reluctant to talk and provided a small sample of the child's spontaneous speech. To explain each of the three tasks (*I*, *C*, and *P*) and to test the *S*'s understanding of each task, *E* always began with the four practice items. To each *S* the *E* administered the tasks, the problems within a task and the items within a problem in accordance with a predetermined schedule. The techniques of administration are described above as "Operations for Testing *Imitation*, *Comprehension*, and *Production*."

It was most expedient to continue testing a child in one session for as long as he proved cooperative and attentive. Three children succeeded in completing the entire performance in only one session each. Usually, however, two or three sessions on successive days were necessary to take a child through all three tasks. With a few unavoidable exceptions, it was possible to make breaks in performance coincide with breaks between tasks. After performing both halves of an item, *S*, whether or not he had answered correctly, was encouraged by *E* with some such remark as: "That's the way." Nonverbal rewards were not used. For the *I* task, in which there were no pictures to hold the child's attention, a "divided attention" technique was sometimes necessary. The *S* was allowed to hold some simple toy and *E* would administer an item whenever the child was not engrossed in the object.

RESULTS

Scoring. There were two records of each experimental session: one on tape and one written on the scene. The scorers took advantage of the information in both records. The criteria for scoring each problem appear in Table 2; a response was marked "correct" if it completely satisfied these criteria and was otherwise marked incorrect.[3] On the *C* task *S* sometimes pointed quickly, then reflected and corrected himself; the last definite pointing is the one we always scored. Two scorers independently scored all of the data (720 items). They agreed on 713 items or about 99% of the total. The seven disagreements, which were almost evenly distributed among the three tasks, were resolved by discussion.

Quantitative Findings. Table 3 shows the

[3] We also devised and tested a more elaborate

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age and sex of each S, the order in which each performed the three tasks, and the number of problems correct for each task and for all tasks combined. Even within the restricted age range represented, there was a correlation between age and total score: $\rho = 0.48$, p slightly above 0.05. The girls did somewhat better than the boys, but the difference was not significant.

Before comparing performances on the three tasks we must report several preliminary analyses. Six Ss performed task C with Set A of the materials and task P with Set B and six Ss did the reverse. A two-way analysis of variance, Groups by Tasks, showed that neither the difference between the two groups ($F = .35$, $df = 1, 30$) nor the interaction of Groups and Tasks ($F = .07$, $df = 2, 30$) was significant. Therefore we will ignore in subsequent analyses the sets of materials used.

TABLE 4

MEAN TASK SCORES AND ORDER OF PERFORMING TASKS

	Imitation	Comprehension	Production
As 1st Task	13.50	10.75	3.50
As 2nd Task	14.25	9.75	5.00
As 3rd Task	13.75	9.75	5.75

Table 4 shows the mean scores of Ss who did each of the tasks as the first task, the second task, or the third task. It is clear that order had no consistent effect on either I or C. On P, there was a slight tendency for Ss who performed P as their second task to do better than those who performed P first, and for those who did P last to score higher than those who did it second. However, it could not be demonstrated that this tendency was statistically significant. Three different analyses were performed: a two-way analysis of variance, Tasks by Order; a Kruskal-Wallis nonparametric analysis of variance covering P as the first, the second, and the third task with p being multiplied by $\frac{1}{2}$ to take account of the fact that the order obtained is the one to be expected if practice on the other tasks facilitates performance on P (see Chassan 1960); and a Randomization Test comparing P as first task with P as third task. In none of these did order produce a p of even 0.1. Therefore we shall ignore in subsequent analyses the order in which tasks were performed.

Because all three tasks involve operations of perception, attention and memory, we predicted that the difficulty of the problems would be similar from task to task. In Table 5 the task scores for each problem appear. On any one problem the maximum possible score is 24 since there were always 2 items responded to by 12 Ss. The Spearman rank correlations for the difficulty of problems from task to task are: $\rho_{IC} = 0.64$ ($p < 0.05$); $\rho_{CP} = 0.72$ ($p < 0.05$); $\rho_{IP} = 0.68$ ($p < 0.05$).

In Table 1 we listed the six possible relations of inequality among the tasks, and now we can report which ones occurred. There might, of course, have been no significant inequalities among I, C, and P, but the Groups by Tasks analysis of variance reported above showed that there were significant differences among the tasks ($F = 16.05$, $df = 2, 5$; $p < 0.01$). We did t-tests between pairs of tasks (IC, CP, and IP) and found that all were significant with $p < 0.01$. The mean number of correct responses of Ss on I was 13.83; on C, 10.08; and on P, 4.75. In short, $I > C > P$. In Table 3 it can be seen that this order holds with striking consistency for individual Ss. For all 12, $C > P$ and, for 11, $I > C$. In Table 5 it can be seen that the order held true for all but one of the grammatical problems; on that one (Mass noun

scoring system that distinguishes nine varieties of partially correct response. High scorer reliability was obtained for this system. However, since only 15% of the total responses fell into the nine additional categories, and since analyses using these categories yielded a pattern of results exactly like the pattern herein reported, we have simply called responses in these categories "incorrect."

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TABLE 8

TASK SCORES ON GRAMMATICAL PROBLEMS IN ORDER OF INCREASING TOTAL DIFFICULTY

Problem	Imitation	Comprehension	Production	Total
Affirmative : Negative	18	17	12	47
sing. Pl. in and person pos. prons.	24	15	8	46
Subject-Object : Object-active voice	19	16	11	46
Pres. Prog. tense : Future tense	20	15	6	41
sing. : Pl. marked by *is* and *are*	20	12	7	39
Pres. Prog. tense : Past tense	17	13	6	36
Mass noun : Count noun	12	13	1	26
sing. : Pl. marked by inflections	13	7	1	21
Subject-Object : Object-passive voice	12	7	2	21
Indirect Object : Direct Object	11	5	3	19

Count noun) *C* was higher than *I* by one point.

Guessing on the Tasks. On a very abstract level the three tasks, *I*, *C*, and *P*, make identical demands on *S*. In each task *E* provides two stimuli (s_1 and s_2) and requires two appropriately matched responses (r_1 and r_2). For *I* the stimuli are the two model utterances and the responses are *S*'s pronunciations of the critical features of these two utterances in an order matching the order of the models. For *C* the two stimuli are again the two utterances, and the responses are pointing appropriately first to one picture and then to the other. For *P* the stimuli are provided by *E* pointing to the pictures, one at a time, and the responses are *S*'s pronunciations of the critical features of the utterances corresponding to the pictures. The problem in all cases is to match r_1 to s_1, and r_2 to s_2.

For an adult *S* the first pointing in any item of the *C* task (e.g., "Show me: 'The sheep are jumping.'") would be a choice between two alternatives and the second pointing would be completely determined by the first. Consequently, for an adult *S* the probability (p) of guessing a correct answer on any item in the absence of grammatical knowledge would be 0.50. This is a substantial probability, and since there do not seem to be comparable opportunities for a chance success on *I* and *P*, where the responses are speech, it may seem that chance gives an advantage to the *C* scores.

However, our 3-year-old *S*s did not handle the *C* task as adults would. On the practice materials, which involved familiar lexical distinctions, all the children did point first to one picture and then to the other, but this was because they were giving the correct answers.

On the grammar contrasts, too, when they saw the solution they pointed first to one picture and then to the other. However, when they did not see the solution, they often pointed twice to the same picture, acting as if the second pointing were completely independent of the first. They sometimes pointed simultaneously at both pictures, and one *S*, on one occasion, gave an unscorable response. The probability of a chance success for these *S*s was clearly less than 0.5. A case can be made for assuming it was 0.25 and a case can be made for assuming it was 0.11; neither case is perfectly satisfactory.

On the *I* and *P* tasks, too, there must have been some possibility of obtaining a chance success. The two relevant responses, r_1 and r_2, were twice produced by *E* just before *S* was asked to respond. If *S* randomly selected for production some number of words from those pronounced by *E*, then *S* would occasionally hit on the right combination to score a suc-

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cess. However, there is nothing to guide us in selecting an exact model for such a process. On the other hand, whenever *S* did produce first the one half of the grammatical contrast (r_1) and then the other half (r_2), the probability that these would occur in the correct order was 0.5, just as p was 0.5 when *S* pointed first to one picture (r_1) and then to the other (r_2). We have pulled out all the cases for each task in which both r_1 and r_2 were produced; the numbers appear in Table 6. Expansion of the binomial for $p = 0.5$ shows that the numbers correct are well above chance on all tasks. It is possible to argue that there are likely to be as many lucky guesses included in the correct response as there are unlucky guesses which appear as incorrect responses. If one subtracts the number incorrect from the number correct to obtain an estimate of the number of successes not obtained by chance, the order $I > C > P$ is preserved and the differences are still all significant with $p = 0.02$ or less.

TABLE 6

CASES IN WHICH THE TWO RELEVANT RESPONSES (r_1 AND r_2) WERE PRODUCED

	Imitation	Comprehension	Production
Total cases	167	168	68
Correct	166	121	57
Correct–incorrect	165	74	46

The comparison of cases in which both r_1 and r_2 were produced disregards the differential probabilities involved in producing, if one had no knowledge of the grammatical contrast involved, two relevant pointings as opposed to two relevant utterances. The probabilities would certainly favor pointing. Table 6 indicates that response production came nearer to guaranteeing success on *P* and on *I* than it did on *C*. However, some such difference would seem to be intrinsic to the tasks in question and so we conclude that insofar as the tasks can be made comparably difficult, the order of control for 3-year-olds is $I > C > P$.

Qualitative Findings. For the student of language acquisition who seeks to discover the grammatical operations that are developmentally prior to attainment of the rules followed by adult speakers, the procedures of the ICP Test will be useful. The incorrect responses to several problems in the present test are sufficiently regular to suggest the nature of the underlying operations. We will describe a single example.

Consider the Subject–Object contrast in the passive voice. While young children probably do not very often hear sentences in the passive voice they very frequently do hear all the individual morphemes involved; they hear *is*, *-ed*, and *by* if not *is chased by*. The *C* score for the passive-voice problems was only five correct. Evidently the sense of the passive construction cannot be guessed from a knowledge of its constituent elements. How do children process this construction when they do not correctly understand it?

Consider a sample pair of sentences: "The girl is pushed by the boy" and "The boy is pushed by the girl." When, for the *P* task, *E* pointed to the picture in which the girl was doing the pushing and asked for its name, *S* sometimes said: "The girl is pushed by the boy" and then, for the other picture, *S* spoke the other sentence. This is an incorrect response that perfectly preserves the form of the sentences but exactly reverses the correct pattern of application to the pictures. Five *S*s responded in this way, and 5 is a large number when we recall (Table 6) that there were only 14 such reversals on *P* in all the data. In addition, these 5 reverse responses seemed to be made with high confidence. What incorrect rule would generate such a performance?

In active-voice sentences, subject and object appear in that order, whereas in passive-voice sentences the order is object and subject. Suppose that the 3-year-old processes each passive-voice sentence as though it were

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in the active voice. "The girl is pushed by the boy" is not computed as: Object Verb in the passive Subject, but rather as: Subject Verb in the active with odd appurtenances. Object. The odd appurtenances are *is*, *-ed*, and *by* which S may take to be signs of some uncommon tense like "will have pushed." Processing the sentence in this way would enable S to maintain the generality of the usual rule of English word order in which the subject precedes the object.

With the Subject Object contrast in the passive voice we turned up a revealing pattern of evidence by accident. If an investigator wanted to use the I-P procedures to test hypotheses about particular aspects of grammatical operation, he could easily design problems that would be revealing by intention.

Discussion

We predicted that the order of difficulty of the ten problems would be similar from task to task for the reason that all three tasks involve operations of perception, attention, and memory which should be affected by the nature of the sentences provided. The order of difficulty was indeed similar from task to task but there does not seem to be any single dimension of the contrasts that will account for the order. The contrast Singular Plural marked by inflections may be harder than the contrast Singular Plural marked by *is* and *are* because the bound morphemes are less well marked acoustically than are the free morphemes. The Subject Object contrast may be easier in the active voice than in the passive voice because children hear fewer passive-voice sentences than active-voice sentences. Probably the order obtained for the problems is a complex resultant of many factors that increase difficulty including the perceptual obviousness of the contrast, the amount of redundancy in the contrast, the length of the total sentences, and the frequency with which the construction has been heard. It should be possible to investigate the importance of these variables with problems designed to that purpose.

Of the possible outcomes listed in Table 1, those that occurred are: $I > C$, $I > P$, and $C > P$. These occurrences reflect some credit on the ideas that led to their prediction and some discredit on the ideas that led to the prediction of their opposites. Because $I > C$ rather than $C > I$, it would seem that imitation is a perceptual-motor skill not dependent on comprehension. It would seem, in addition, that the highly systematic speech system is under more complete control at 3 years than is the less systematic and more complex referential system.

The conclusion that imitation is a perceptual-motor skill that does not work through the meaning system is supported by certain details in the data. Consider, for example, the Indirect object Direct object contrast in such a pair as: "The woman gives the bunny the teddy" and "The woman gives the teddy the bunny." In five cases when Ss were given this problem with appropriate pictures for the *P* task, they transformed the original sentences so as to express the indirect object with a prepositional phrase. They pointed correctly but instead of saying, "The woman gives the bunny the teddy" they said "The woman give the teddy to the bunny"; the latter construction is probably the more familiar of the two. If on the *I* task, these Ss had decoded the sentences into meanings, as they do on the *P* task, the same transformation ought to have occurred. It never did occur. On the *I* task S either correctly reproduced the originals or made errors that were not transformations. It seems reasonable to conclude that the imitation performance did not work through the meaning system.

Because $I > P$ occurred and $P > I$ did not, it would seem that increasing the number of psychological operations to be performed in near simultaneity increases the difficulty of the task. It would seem, in addition, that the presence of the referential contrast either

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does not have a facilitating effect on the perception and retention of the sentence contrast or else that the effect is less powerful than the one that results from increasing the number of operations. We have already concluded that imitation is a perceptual-motor performance and that speech is a simpler system than reference. It is consistent now to add that the sentences of the test could usually be differentiated and retained without the support of reference.

Because $C > P$ occurred and $P > C$ did not, it would seem that the motor control of speech is more complicated than the motor control of pointing. We could not imagine that the contrary of this proposition would be true; and so this prediction was labelled obvious and the obvious worked out.

How stands the thesis that understanding precedes production in the development of child speech? The thesis is true if by production we mean task P, since C scores were higher than P scores. This outcome suggests that children learn a lot about the referential patterning, the stimulus control of grammatical forms, before they produce these forms. This learning which precedes the linguistic response may be a purely s-s registration of the correspondence between constructions produced by others and the circumstances of production, but, as our operation for testing comprehension shows, it need not be. Understanding could be s-r learning in which the r is some nonlinguistic response such as pointing. Production occurs when the appropriate linguistic response begins to appear, conforming to a stimulus pattern that may originally have been established in connection with nonlinguistic responses.

The thesis that understanding precedes production is false if by production we mean task I, since C scores were lower than I scores. It is very possible, however, that this latter outcome would reverse with still younger children. The longest sentences of the ICP Test were only eight morphemes long which means they were easily within the sentence-programming span of 3-year-old children. However, the much shorter span of children at about 2:6 should compel such younger children, in the I task, to "reduce" the model sentences of the ICP Test. Brown and Fraser (1963) have shown that such reductions are accomplished by dropping the function words of the sentence, leaving a "telegraphic" string of nouns and verbs. The function words are the essential elements in which the sentences of the ICP Test contrast. Perhaps, then, 2-year-olds will omit these words in I and yet show by correct pointings on C that they can internally process more words than they can "print out." Such an outcome would suggest the existence of a longer span for internal sentence computation than for sentence production. We are now trying to adapt the ICP procedures to that least docile of subjects: the child between two and three.

Summary

The familiar assertion that, in language development, understanding precedes production was tested for 10 grammatical contrasts with 12 3-year-old children. Understanding was operationalized as the correct identification of pictures named by contrasting sentences. Production was operationalized in two ways: (a) as the correct imitation of contrasting features in sentences without evidence of understanding; and (b) as the correct production of contrasting features in sentences applied appropriately to pictures. Production in the second sense, proves to be less advanced than understanding in 3-year-old children. However, production in the sense of imitation proves to be more advanced than understanding in 3-year-olds.

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